

Amendment under 37 CFR §1.116  
Attorney Docket No.: 062610  
Application No.: 10/583,152

### **REMARKS**

Claims 1, 3-16, 18 and 19 are pending in the present application. Claims 16, 18 and 19 are withdrawn from consideration. Claim 1 is herein amended. No new matter has been entered.

### **Claim Rejections - 35 U.S.C. § 103**

Claims 1, 3-9 and 11-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over **Wu** (US 5,898,014) in view of **Yagi** (US 6,376,423); and claim 10 was rejected under 35 U.S.C. § 103(a) as being unpatentable over **Wu** and **Yagi**, and further in view of **Allison** (US 2002/0115730).

Favorable reconsideration is requested.

(1) Applicants respectfully submit that Wu in view of Yagi does not teach or suggest:

a catalyst for manufacturing synthesis gas containing carbon monoxide and hydrogen as principal ingredients from feedstock gas containing hydrocarbon having 1 to 5 carbon atoms in each molecule and oxygen, [and]

wherein minimum selectivity of the catalyst for each of CO and H<sub>2</sub> is 90%

as recited in amended claim 1, and that these features would not have been obvious.

Wu discloses a TWC (three-way conversion) catalyst for exhaust gas from automobile engines. As pointed out in the previous Response, the requirements for TWC catalysts and those for CPOX (catalytic partial oxidation) catalysts such as the catalyst of the present invention are completely different from each other. (See Response, August 15, 2008.) Since CO and H<sub>2</sub> should not be emitted from an automobile engine into the environment, the CO and H<sub>2</sub> selectivities of a TWC catalyst must not be high.

The following test data prepared by Applicants demonstrates that a TWC catalyst, generally equivalent to the catalyst of Wu, does not exhibit such high selectivities as of at least 90% for both of CO and H<sub>2</sub>.

The catalyst support (carrier) prepared and used in the examples of Wu is made from a co-precipitate of zirconia and rare earth elements (ceria, praseodymia and neodymia). Accordingly, a co-precipitate of ceria and zirconia (manufactured by Daiichi Kigenso Kagaku Kogyo CO., LTD.) was baked together with magnesia to prepare a catalyst support (catalyst support A) and used in the performance test.

Further, in order to confirm that the above material of Daiichi Kigenso Kagaku Kogyo CO., LTD. is a co-precipitate of ceria and zirconia, the Applicants prepared a catalyst support (catalyst support B) by baking a co-precipitate of ceria and zirconia together with magnesia and X-ray spectra of support A and support B were compared with each other.

Preparation of catalyst support A

1. Twenty-five grams of a co-precipitate of ceria and zirconia manufactured by Daiichi Kigenso Kogyo CO., LTD. (in Osaka, Japan). 21.02g of Mg(OH)<sub>2</sub> and 2.37g of graphite carbon were mixed and compression molded at 150kN for 5 minutes to form a molded product with a size of 25mmF.

2. The molded product was baked in air for 6 hours at 1200°C with a baking rate of 100°C/hr.

3. The baked, molded product (catalyst support A) had a second/first ingredient ratio of 0.332 mol/mol, and a third/first ingredient ratio of 0.165 mol/mol.

Preparation of catalyst support B

1. Into 2 liters of water were dissolved with stirring 126g of  $\text{Ce}(\text{NO}_3)_6 \cdot 6\text{H}_2\text{O}$  and 108g of  $\text{ZrO}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ .
2. Into the above-formed solution was added slowly with stirring aqueous ammonia (28% by weight) until the pH value of the solution becomes 8.5 to cause co-precipitation of the solutes to occur. The rate of stirring was 250 to 270 rpm.
3. The solution having caused co-precipitation was filtered by means of an aspirator.
4. The obtained co-precipitate was put into 2 liters of water, then stirred at a rate of 250rpm for 5 minutes, and filtered. This operation was repeated three times to wash the co-precipitate.
5. The washed precipitate was dried at  $60^\circ\text{C}$  for 12 hours or more.
6. The dried precipitate was baked in air for 5 hours at  $500^\circ\text{C}$  with a baking rate of  $100^\circ\text{C}/\text{hour}$ .
7. Thirty three grams of the baked precipitate, 24g of MgO and 5.7g of graphite carbon were mixed and compression molded at 90kN for 5 minutes to form a molded product with a size of 20mmF.
8. The molded product was baked in air for 5 hours at  $500^\circ\text{C}$  with a baking rate of  $100^\circ\text{C}/\text{hour}$ .
9. The baked, molded product (catalyst support B) had a second/first ingredient ratio of 0.213 mol/mol, and a third/first ingredient ratio of 0.170 mol/mol.

X-ray diffraction spectra of catalyst A and catalyst B

X-ray diffraction spectra of support A and support B were measured and compared with each other. Good accordance of the spectra will show that support A and support B had substantially the same crystal structure. See the attached figure.

Preparation of catalyst using catalyst support A

1. Support A prepared above was ground and then sieved to have a size of 0.36 to 0.43mmF, which is used as a carrier in the following steps.
2. Onto 4.00g of the prepared carrier was dropped 210mg of an aqueous solution of rhodium acetate with a concentration of 39000ppm to impregnate the carrier with the rhodium acetate solution and the impregnated carrier was dried in air for 1 hour at room temperature.
3. The dried, impregnated carrier was further dried in air for 16 hours at 60°C and subsequently, the further dried, impregnated carrier was baked in air for 3 hours at 950° C with a baking rate of 100°C/hour to obtain the catalyst with a rhodium content of 2000ppm.

Synthesis gas manufacturing test

Synthesis gas manufacturing test was carried out by using the above-obtained catalyst under the same conditions as in Examples 1 to 6 of the present application. The test results are shown below:

Methane conversion rate:	69.9%
CO selectivity:	84.5%
H <sub>2</sub> selectivity:	90.1%

As seen above, the catalyst, which is substantially equivalent to the catalyst of Wu, exhibited a lower performance in terms of methane conversion rate and CO selectivity.

Since the catalyst of Wu is not for manufacturing synthesis gas as demonstrated above and explained in the Response of August 15, 2008 and the catalyst of Wu does not have selectivity for each of CO and H<sub>2</sub> of at least 90%, the present invention would not have been obvious based on Wu even if Wu can be modified by the teachings of Yagi as alleged by the Office Action.

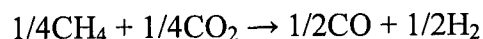
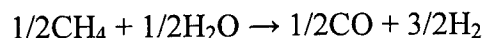
(2) Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art to combine the teachings of Wu and Yagi.

Yagi discloses a so-called ATR (auto-thermal reforming) process which is described in the prior art section of the specification. The ATR process is a two-step process comprising a first step of combustion and a second step of reforming as follows:

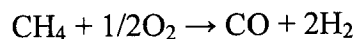
(first step; combustion)



(second step; reforming)



(hence as a whole)



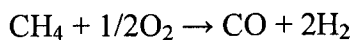
In the ATR process, the first combustion step is fast while the second reforming step is slow, and the whole reaction proceeds under equilibrium of the first and second steps. That is

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combustion (exothermic reaction) proceeds in the upstream region of the catalyst layer and reforming (endothermic reaction) proceeds in the downstream region of the catalyst layer. Thus, the ATR process has a problem of forming hot spots in the upstream region of the catalyst layer, as described in the specification.

On the other hand, the CPOX (catalytic partial oxidation) process comprises a single step, which proceeds very fast as compared to the second reforming step in the ATR, as follows:

(partial oxidation as a sole step)



Thus, the CPOX process provides a dramatic improvement which has solved the problem of the ATR process. Thus, to one of ordinary skill in the art, it would not have been obvious to combine Yagi, which only discloses the conventional ATR process, with Wu which is used for automobile exhaust gas treatment and not for synthesis gas production.

For at least the foregoing reasons, claim 1 is patentable over the cited references, and claims 3-15 are patentable by virtue of their dependence from claim 1. Accordingly, withdrawal of the rejection of claims 1 and 3-15 is hereby solicited.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

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If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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AGM/adp  
Attachment: Figure

